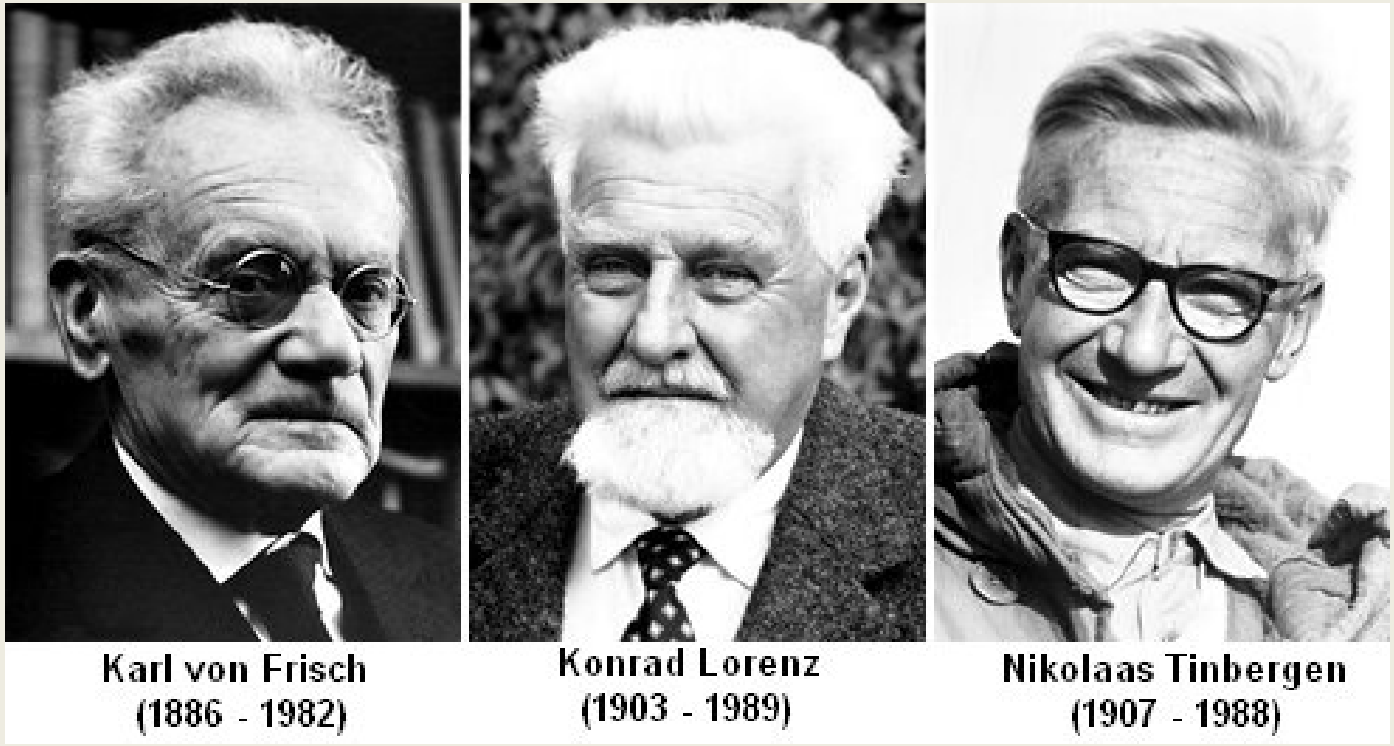
What is Animal Behavior?

Scientific study of animal behavior

Ethology: study of animal's natural behavior



Karl von Frisch
(1886 - 1982)

Konrad Lorenz
(1903 - 1989)

Nikolaas Tinbergen
(1907 - 1988)

Nobel prize: 1973

Four questions to study animal behavior

Proximate mechanisms:

1. **Causation** (Mechanism): what are the stimuli that elicit the response, and how has it been modified by recent learning?

2. Development (**Ontogeny**): how does the behavior change with age, and what early experiences are necessary for the behavior to be shown?

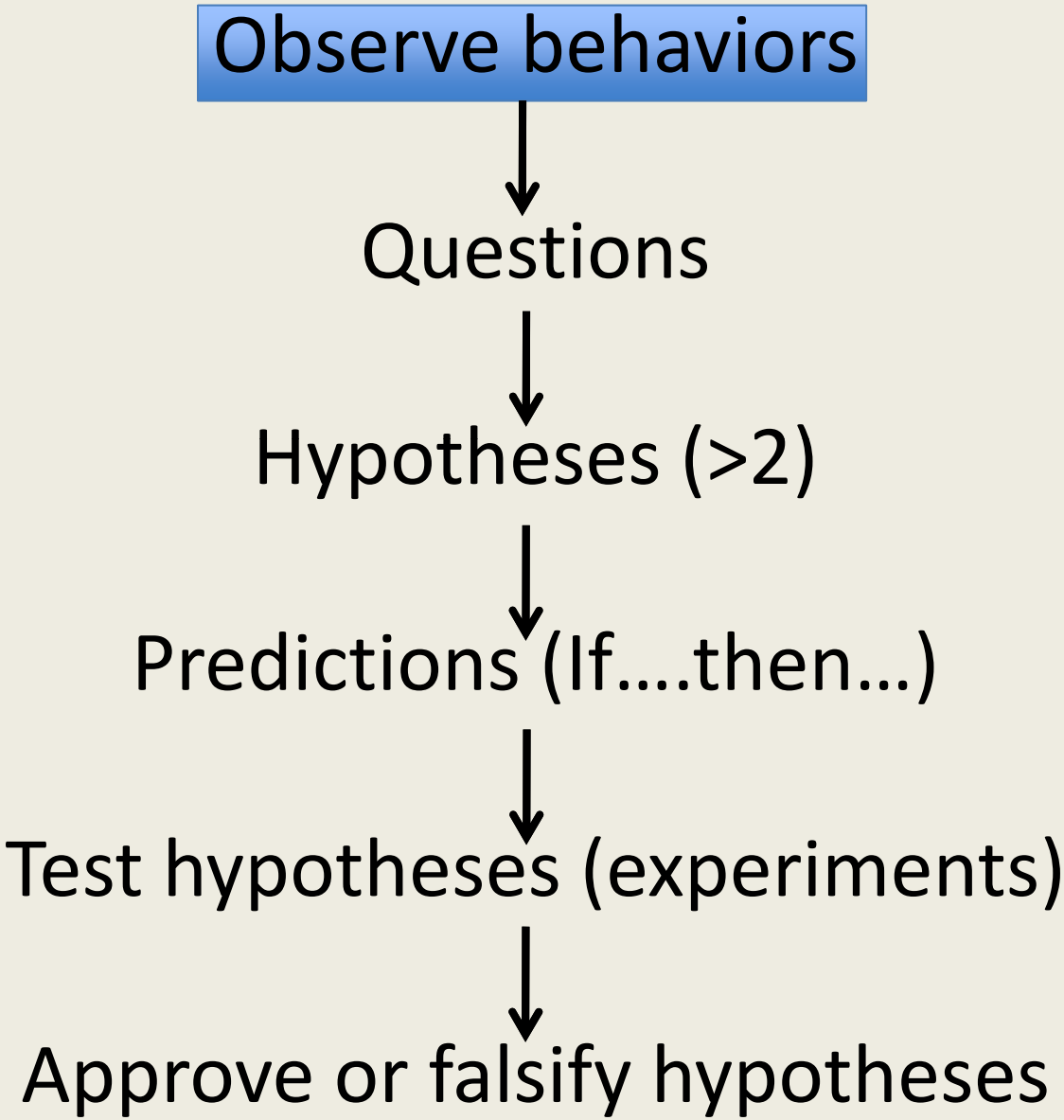
Ultimate mechanisms:

3. Evolution (**Phylogeny**): how does the behavior compare with similar behavior in related species, and how might it have arisen through the process of phylogeny?

4. Function (**Adaptation**): how does the behavior impact on the animal's chances of survival and reproduction?

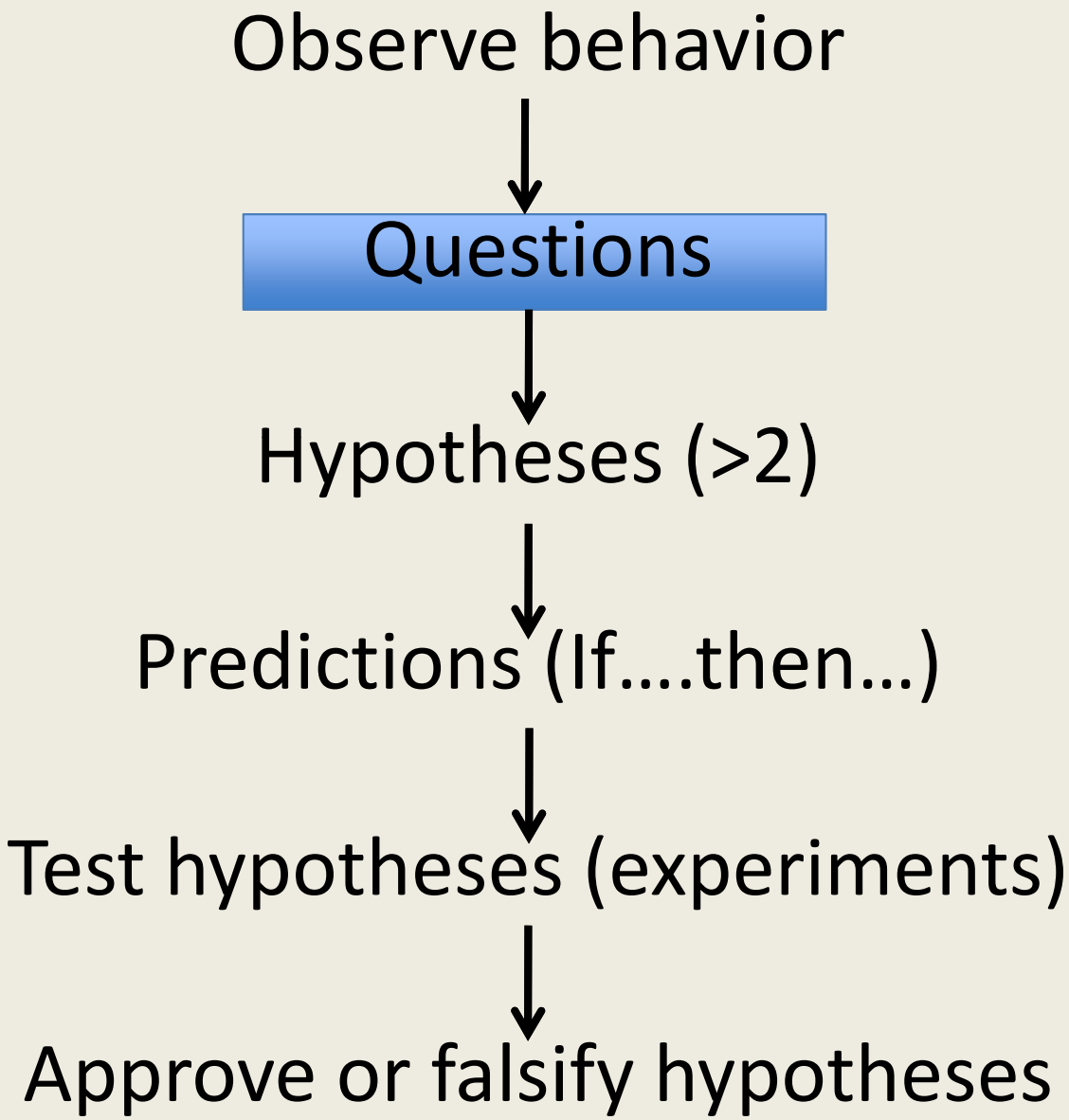
Nikolaas Tinbergen

Scientific study of Animal Behavior
Hypothesis-testing


Observe behaviors
Questions
Hypotheses (>2)
Predictions (If….then…)
Test hypotheses (experiments)
Approve or falsify hypotheses

Observe, observe, and observe!

~ Ivan Pavlov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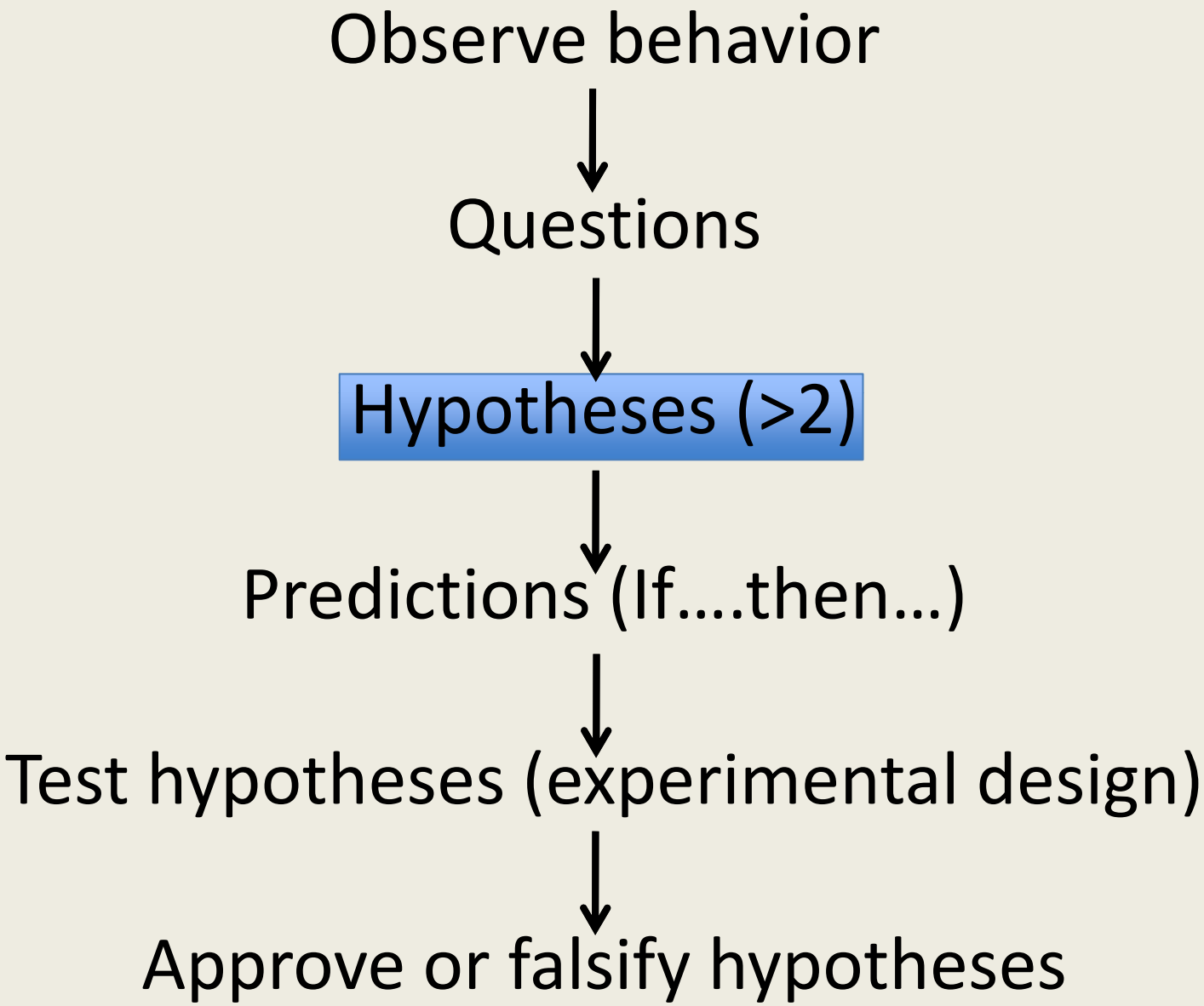
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Hypothesis

1. Testable

2. Multiple hypotheses to address a question

3. Assumption: Natural Selection

Hypotheses proposed are based on the assumption of animal behavior is evolved through natural selection.

Natural selection

The process of evolutionary change when individuals differ in biological inheritable traits that are correlated with individual reproductive success

Natural selection: Darwin's observations and inference

1: members of a population often vary greatly in their traits

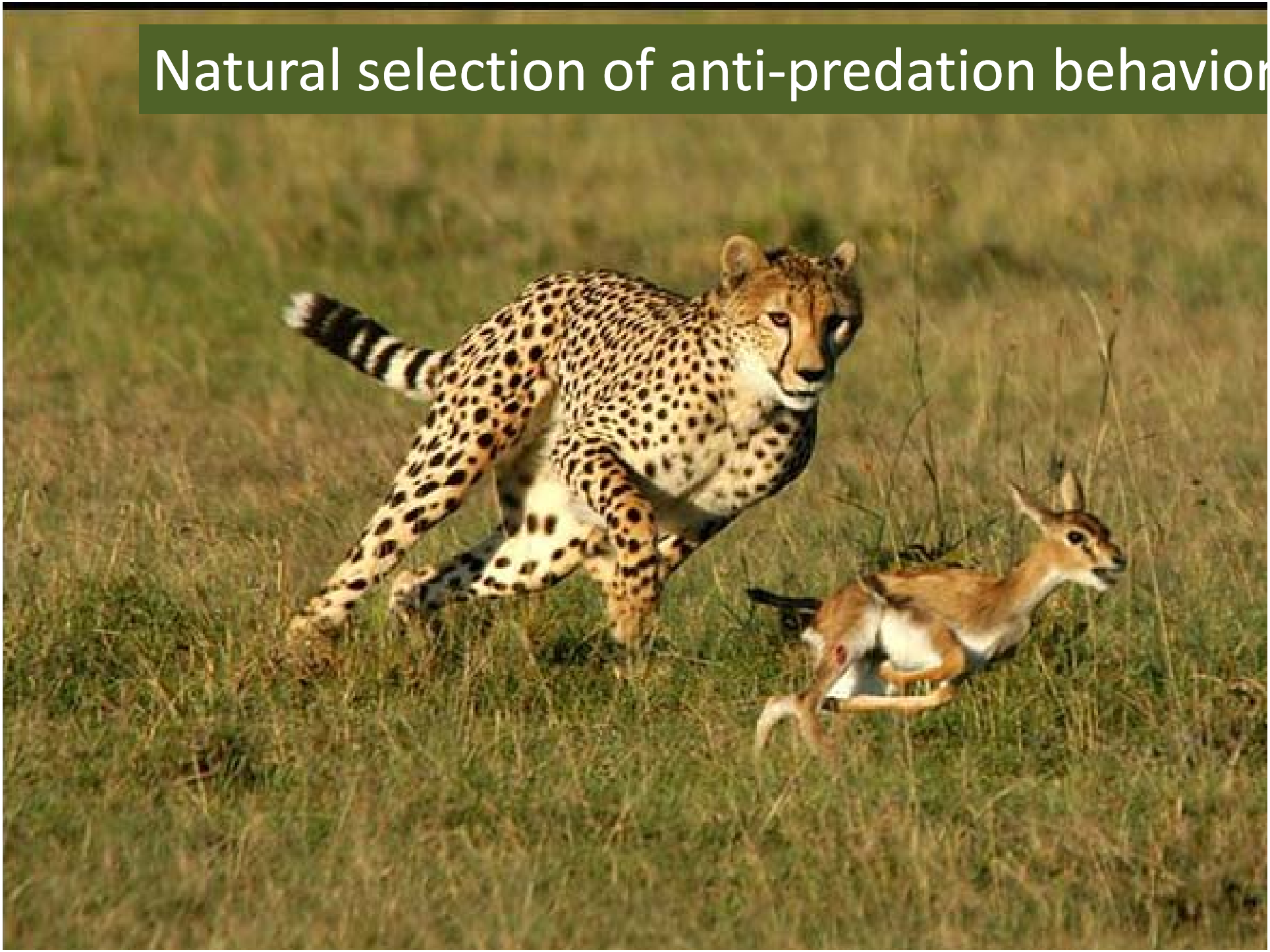
2: Traits are inherited from parents to offspring.

3. All species are capable of producing more offspring than their environment can support

4. Owing to lack of food or resources,
many of these offspring do not survive.

Inference : Individuals whose inherited traits give them a higher probability of surviving and reproducing in a given environment tend to leave more offspring than other individual

Natural selection of anti-predation behavior



Natural selection and evolution of animal behavior

1: members of a population often vary greatly in antelope's running behavior traits

2: Running behavior traits are inherited from parents to offsprin

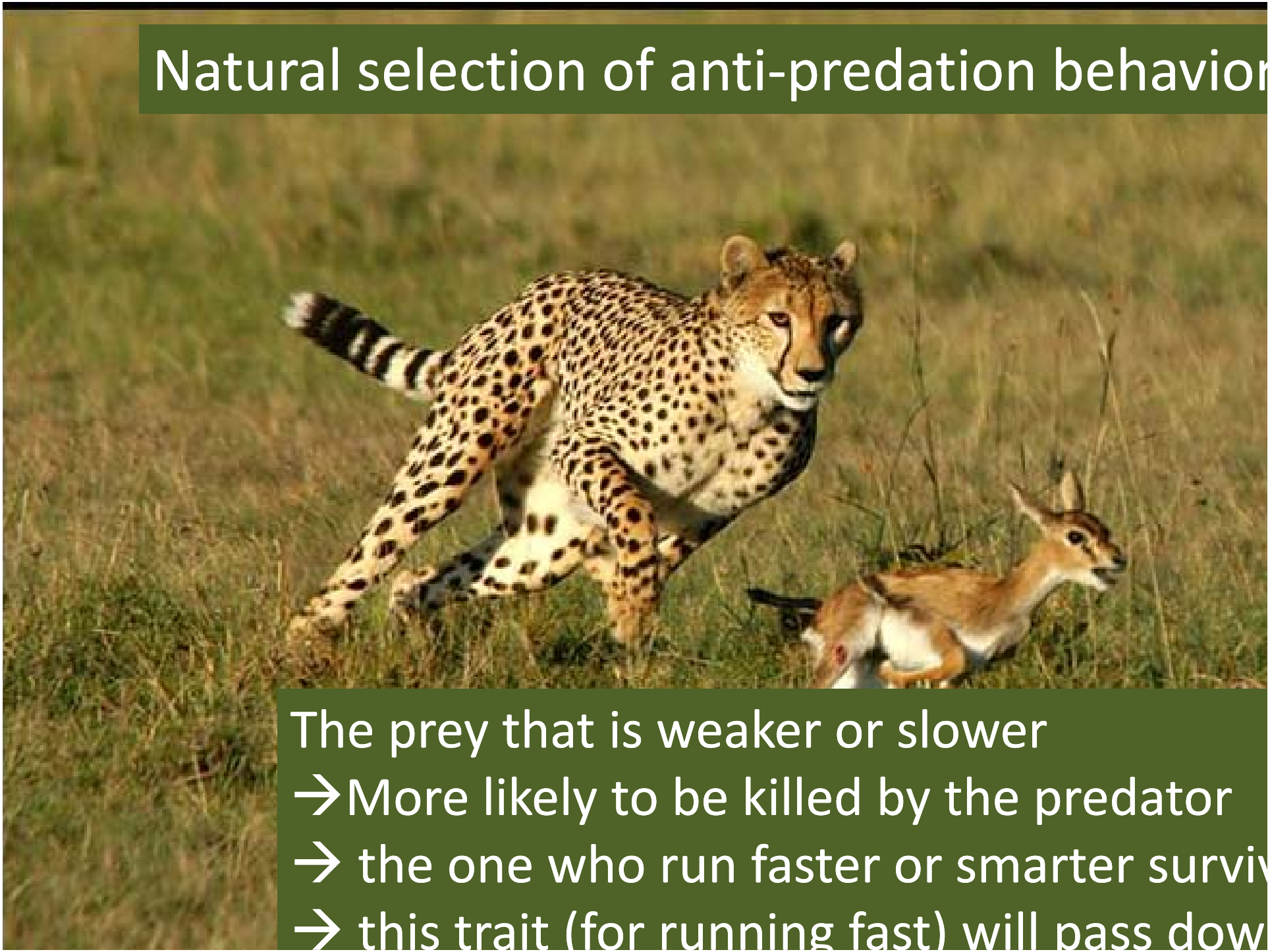
3. All species are capable of producing more offspring than their environment can support

4. Owing to lack of food or resources, or predation many of these offspring do not survive.

Inference : Individuals whose inherited running behavior traits give them a higher probability of surviving and reproducing to leave more offspring than other individuals

Antelopes evolve faster and faster running behavior

Natural selection of anti-predation behavior



The prey that is weaker or slower

→More likely to be killed by the predator

→ the one who run faster or smarter survi

→ this trait (for running fast) will pass dow

Food begging behavior evolves through natural selection?

Natural selection and evolution of Begging behavior

1: Members of a clutch of birds vary greatly in begging behavio

2: Food begging behavior are inherited from parents to offsprir

3. All species are capable of producing more offspring than their environment can support

4. Owing to lack of food or resources, many of these offspring do not survive.

Inference : Individuals whose inherited begging give them a higher probability of surviving (louder begging calls induce more parental care) to leave more offspring than other individuals

1. Observation: food begging behavior in baby birds
2. Questions: why do they beg?
   how do they beg?

3. Hypothesis:
   (why do they beg? Get parent's attention, signal hunger)
   (why do they beg? Compete with sibling)
   (how do they beg? Use their vocal organ to produce calls)

4. Prediction:
   If the purpose of begging is to get parents' attention and food, then we predict that if they don't beg, they parents will not feed

5. Experimental designs

6. Based on experimental results,
   Approve or falsify your hypothesis….
   If falsify, then come up with another hypothesis…..

How do you design an experiment to test the begging call hypothesis?

Proximate and Ultimate causes

Case study: Birdsong

Winter wren

Nightingale

The earth has music for those who listen

~ William Shakespeare

Four questions to study animal behavior

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Nikolaas Tinbergen

What questions do you come up with?

"Why" question
Ultimate cause

Function (adaptation of behavior)
Why do birds sing?

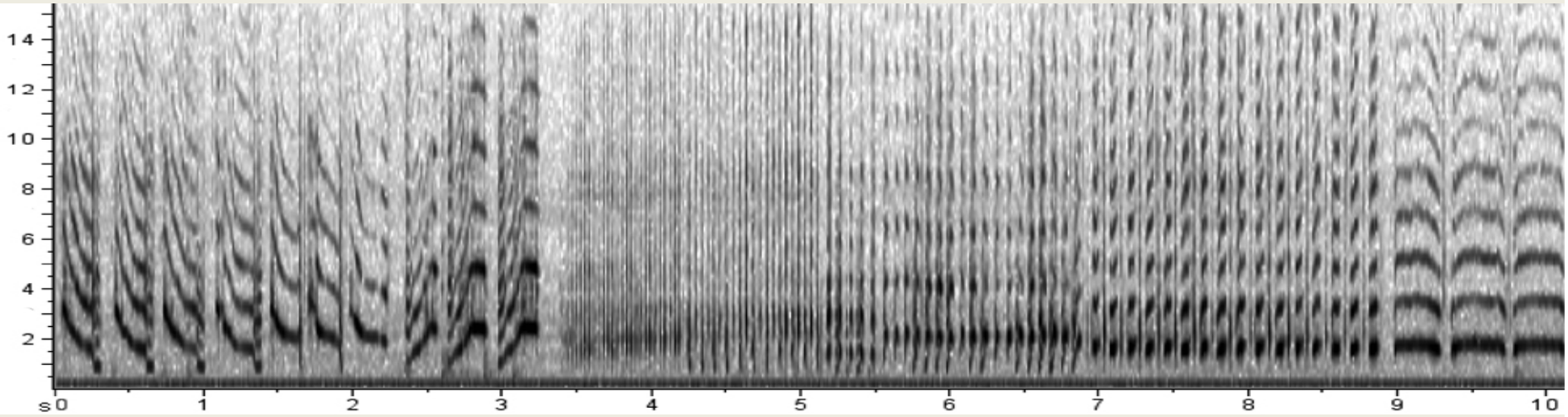
Function of birdsong: to defend territory?

Territorial males lost their territory if they were temporarily muted.

Function of birdsong: 2.Female attraction?

Female canaries exposed to playback of large repertoires of male songs built nests faster and laid more eggs than did those females exposed to smaller song repertoires: females are attentive to attributes of male song, and their choices have played a role in the evolution of oscine singing behaviors.

Kroodsma, 1978



Birdsong: Female attraction?
design an experiment? – mute the bird

“Why” question
Ultimate cause

Evolution (phylogeny)
How does birdsong evolve?

Evolution (phylogeny)
How do birdsong evolve?

Rooster: simple sounds

Songbird: complex song repertoire

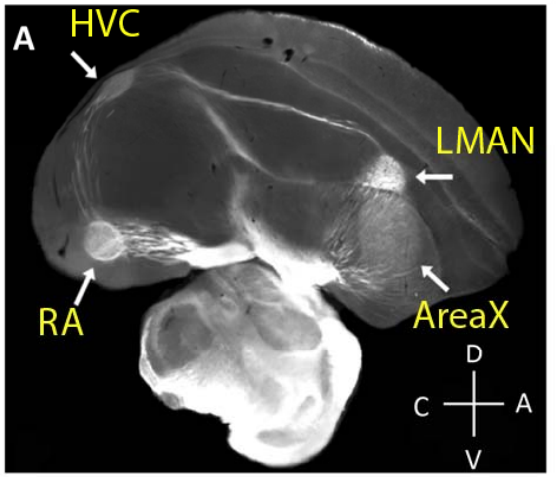
How do birds sing?

"How" question

Proximate cause

Neural mechanism of singing
(what genes/hormone control singing)

Specialized brain pathways for bird singing



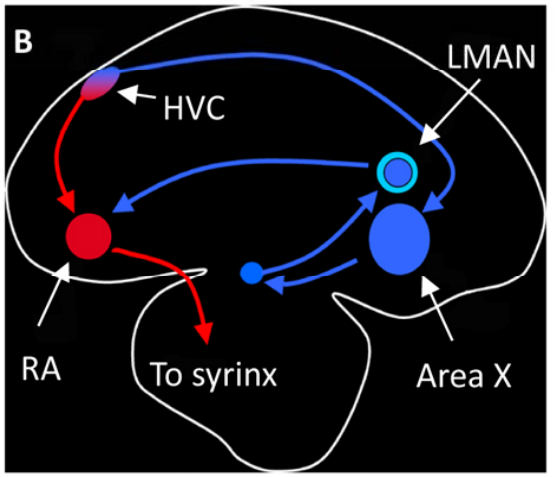
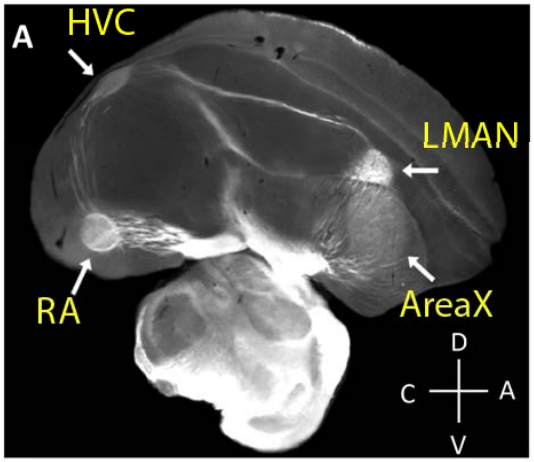
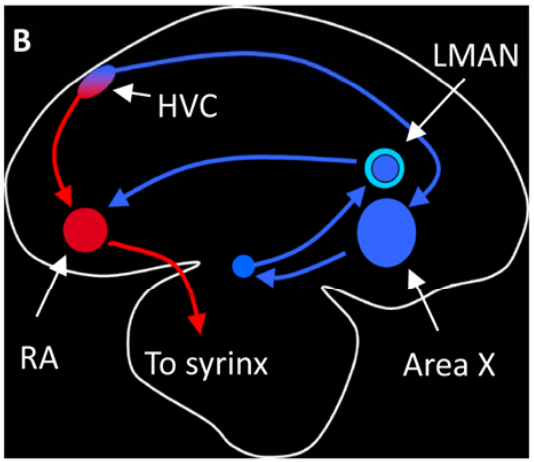


Figure 1. (A) Dark field image of a brain section (saggital) through several song nuclei. (B) Circuit diagram of song system.

Specific gene (*ZENK*) during singing





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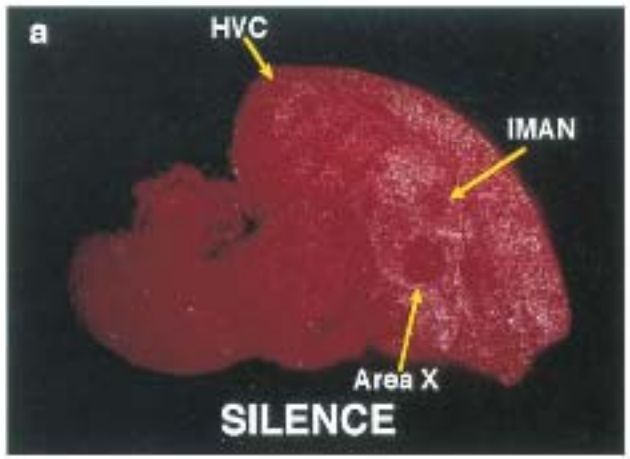
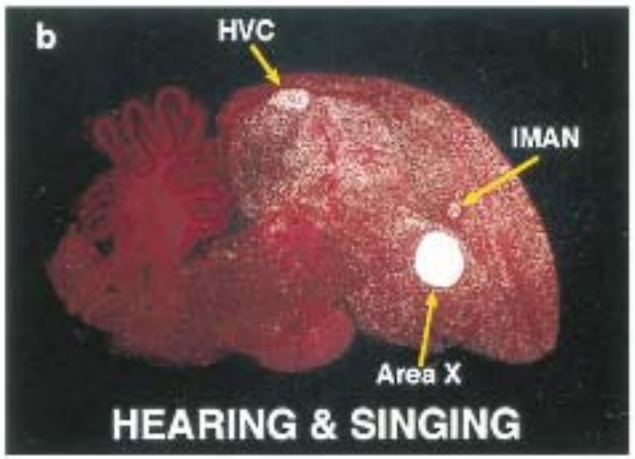
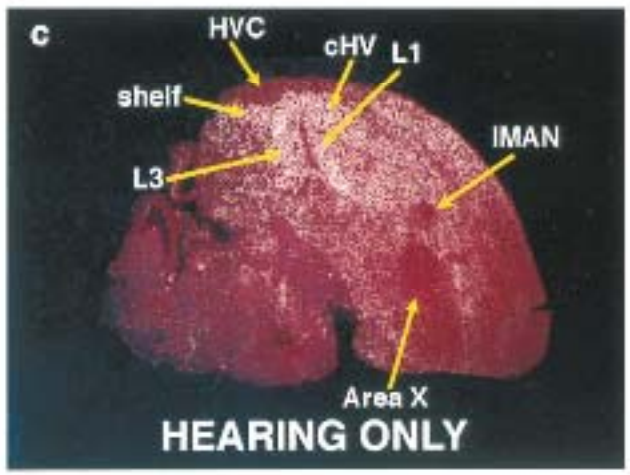
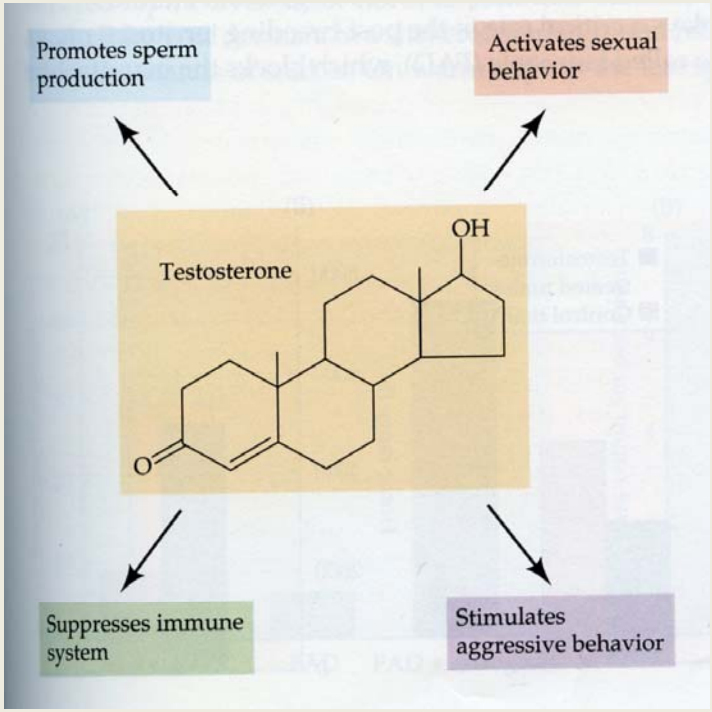
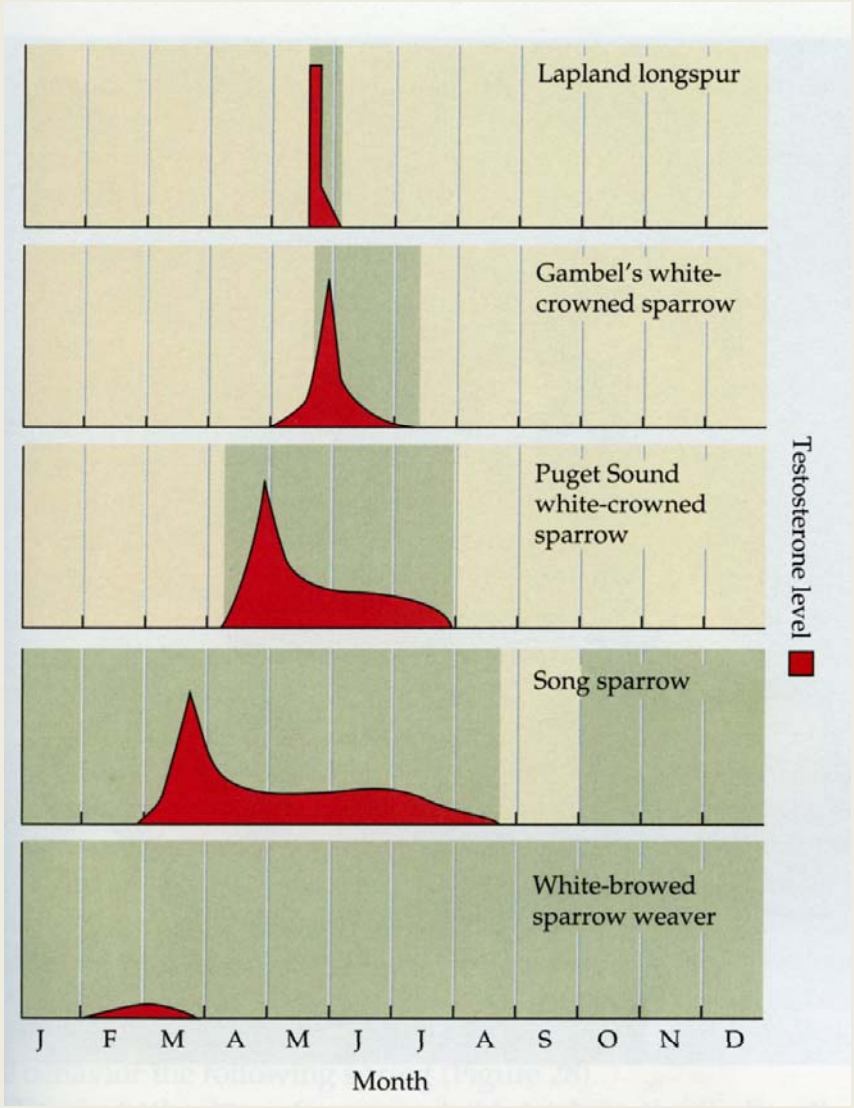






Testosterone and singing behavior





Quiz #1

Wing-flipping of *Automeris* moth

Proximate causes or Ultimate causes?

1. How do the moth's muscles make its wings move, and what controls those muscles?

2. What do moths gain by wing-flipping?

3. Has this behavior changed over evolutionary time?

4. Did the foods the moth ate as a caterpillar influence how it behaves as an adult?

5. Did the moth inherit this behavior from its mother/father?